NOTES ON PLANNING OF AERIAL PHOTOGRAPHIC PROJECTS

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OFFICE OF THE ADMINISTRATOR
AGRICULTURAL ADJUSTMENT ADMINISTRATION

NOTES ON PLANNING OF AERIAL PHOTOGRAPHIC PROJECTS

In order to assist those charged with the responsibility of planning, contracting and executing aerial photographic projects, there are attached maps and data covering a record of some 37 years for 144 stations giving the average number of days in which clouds were 0.1 or less. It should be borne in mind that the number of days thus shown, in addition to being average, can be used as an index only. For example, flying can be undertaken for a few hours when clouds are more than 0.1, although the coverage may be but fifty square miles. On the other hand winds may be such that though the day is cloudless, no photography can be attempted.

Studies made on this year's flying show that the information gathered can be regarded as an index, close enough that it can be used to advantage. A few articles, on the subject of aerial photography, in which the number of flying days per month is given tend to support the use of the data herein given. Present use of this data does not mean that we have finished study of this aspect of aerial photography. In order that we may have a better index of photographic days, our reports must be so designed that the information requested

can be used to determine the coefficient of correlation between what may be expected and the index now being used.

All estimates are to be based upon average time shown on map. In order to estimate coverage use 300 square miles per photographic day for each plane, when the unit is a group of counties. When single counties constitute the unit, the probable average to use is about 275 square miles per day for each day of flying. These figures are of course average. A high speed plane may cover 60% more, or on some days that are clear for a longer period of time than usual, greater coverage may be obtained.

The original flying, however, may not produce satisfactory results. In order to provide for reflights which must be made both at the contractor's discretion and that of the government it is necessary to allow 25 percent as an average. In scheduling, it is not feasible to break down reflights county by county. For estimating purposes, assume reflights take place only after all original flying is completed, allowing a two week interval between the end of original flying and the beginning of reflights. Thus if the project area is 4,800 square miles and the unit is a group of counties the number of photographic days required for original flying is 16 days, for reflights 4 days, or twenty days, with a two week interval between the two flying periods, which can be added to the total number of months required.

In programing future projects, planes should be on the project area, if possible, only during months that are near average or above. For example, no planes should be in Florida between June 1st and October 1st. Coordination in planning by the divisions will be most essential. Project areas should be limited in size, or the number of planes increased so that there is a reasonable expectation of completion in the time set up.

In order to use the map effectively a brief explanation of the method to be used in calculating average photographic days expected follows. For the purpose of illustration two of North Central projects, one in Minnesota and one in Indiana, have been used. Plot the stations in or near the area. Connect with straight lines and draw perpendicular bisectors. Areas falling with the boundaries of the perpendicular bisectors are controlled by the station which they bound. Cross-hatched areas in figures 1 and 2 show how this is done. Each area is then planimetered and its ratio to the whole area constitutes the station constant.

For the subsequent discussion the above projects shall be used to illustrate the method of estimating. Both projects are assumed to start July 1, 1937, and each call for 1 plane to be on project. Each also calls for 1 set of contact prints (positype paper) and 1 set of photo index maps 2" to mile, and in each the project unit area is by single county. All calculations which follow have been made on slide rule.

Minnesota, area of project 10,375 square miles

Original flying $\frac{10,375}{275} = 37.6$ days

Reflights at 25% 9.4 days

Total 47.0 flying days

Indiana, area of project 10,796 square miles

Original flying $\frac{10,796}{275} =$ 39.2 days

Reflights @ 25% 9.8 days

Total 49.0 flying days

Minnesota Stations	No. days per mo. (From map) (1)	10 year Percent (2)	Station Constant (3)	No. Days (3)X(1)	10 Year Percent (3)X(2)
Minneapolis	5.1	33	.59	3.01	19.5
Charles City	5.4	55	.23	1.24	12.6
La Crosse	5.0	29	.18	0.90	5.2
				5.15	37.3

Use 5.2 days per month and 37% below average for contingency.

Indiana Stations					
Evansville	5.5	32	.38	2.09	14.4
Louisville	6.4	24	.36	2.30	8.6
Cincinnati	5.2	25	.14	0.73	3.5
Indianapolis	4.8	29	.12	0.58	3.5
				5.60	30.0

Use 5.6 days per month and 30% below average for contingency.

Time calculation. For each project area multiply the average number of days as derived above by the percentage indicated on the tabulation shown on the map in order to get the number of days for each month. For example, Minnesota is in region 8. For July the number of days is 5.2 times 118% or 6.1 days. The detailed calculation for each project follows:

Minnesota.

The map of snow cover shows for the project area an average of about 90 days snow cover. However, the contract specifications call for photographs substantially free from snow, and, therefore, the contractor estimates that he can probably fly to about November 1st and resume flying about April 1st, which must be considered in the estimate. In the future such a possibility must be considered in advance and eliminated by cutting down the size of the project and also by calling for an ending of the contract if all flying is not completed by a definite date or at first snowfall. Savings in cost can be made only by exercising such foresight.

Month	No. of Days	Cumulative Days	Month	No. of Days	Cumulative Days
July	6.1	6.1	May	4.2	34.0
August	6.0	12.1	June	4.5	38.5
September	6.4	18.5	July	6.1	44.6
October	7.0	25.5	August	6.0	50.6
April	4.3	29.8			

The elapsed time required will be on an average 14 months, to which should be added 2 weeks allowance for reflight interval.

Indiana.

The map shows an average of thirty days snow coverage. It is probable that for this state, since the project covers the southern border, flying may be assumed to stop on December 1st and resumed on February 15th on an average basis, but March 1st would be a safer date to use for estimating.

Month	No. of Days	Cumulative Days	Month	No. of Days	Cumulative Days
July	5.0	5.0	March	4.8	38.3
August	5.6	10.8	April	4.8	43.1
September	7.0	17.8	May	4.6	47.7
October	9.1	26.9	June 15th	2.2	49.9
November	6.6	33.5			

The elapsed time required will be 11 1/2 months, and allowing a two-week reflight interval, the total time for estimating purposes will be 12 months.

Each project should be estimated in detail as to cost. At this time, however, there are too many variable factors which have not yet been evaluated to make estimating simple for the divisions. Until such time, average figures can be used to arrive at an approximate cost. Consequently, once the elapsed time has been determined, the number of flying days, and the photographic materials required by the terms of the contract, the following average figures can be used for the present:

Waiting time, one thousand dollars per month

Flying time, one hundred dollars per day

Aerial film, \$46 per roll

Contact prints (positype), \$0.30 each

Photo index maps, \$23 each

If the contract should call for other materials than the above table includes, the approximate cost will be supplied on demand.

In order to set up a protection against bad weather, it will be necessary to provide a contingency. In this method of estimating, the contingency percentage is derived from page 6, which is the percent below average which occurs one year in ten. This percentage is to be applied to the waiting cost, since the contractor may have to prolong the duration of the project in about that proportion. It is obvious that this method is applicable where no special conditions are to be encountered. If special conditions are foreseen which tend to increase the cost, the matter should be discussed with the Office of the Administrator in order to arrive at some method for evaluating such conditions.

Caution: This method of estimating can be used only with areas of about 1500 square miles and over, close together and not widely scattered.

In accordance with the above tabulation, we may now estimate the approximate cost of the two projects above examined.

Minnesota.

Since area is 10,375 sq. miles and average contact print covers about 1.25 sq. miles, therefore 8,300 contact prints are needed.

Number of photo index maps $= \frac{8300}{55} = 151$ maps

Number of rolls of film $= \frac{10,375}{100} = 104$

The summary of estimate follows:

Waiting costs 14 1/2 months @ $1,000	$14,500
*Flying 50 days @ $100	5,000
Photographic, 104 rolls @ $46	4,760
Contact prints 8300 @ $30 per 100	2,490
Photo index maps 151 @ $23 each	3,480
Total	30,230
Ownership overhead @ 15%	4,500
	34,730
Profit @ 15%	5,200
Total	39,930
Contingency 37% x 13,500	5,000
	$44,930

Estimated cost per sq. mile $\frac{44,930}{10,375} = \$4.33$

Indiana.

Area is 10,796 sq. miles, therefore there are required 108 rolls of film, 8650 contact prints and 157 photo index maps. Twelve months flying requirements with fifty-two days of actual flying, are shown in time schedule.

Waiting costs 12 months @ $1,000	$12,000
*Flying 52 days @ $100	5,200
Photographic 108 rolls @ $46	4,960
8650 contact prints @ $30 per 100	2,600
157 index maps @ $23 each	3,620
	28,380
Ownership overhead @ 15%	4,250
Total	32,630

*Includes an allowance of 3 days for getting to and from project area from company's headquarters.

Profit @ 15%	4,900
	37,530
Contingency 30% x 11,160	3,350
	40,880

Estimated cost per sq. mile $\frac{40,880}{10,796}$ = \$3.78

In addition to such data required by the Office of the Coordinator, it will be necessary to submit additional information when presenting the project to the Office of the Administrator. A brief summary should be submitted showing that it is more economical to check participation in each county by using aerial photographs than by any other method. Special care should be exercised in studying each county for there may be instances in which the whole county need not be flown, but only portions of it.

With this summary, a recapitulation of the estimate, should be included. The recapitulation need be very brief and in the following form.

State_____________ Area in sq. miles_____

Number of rolls of film_____ Number of Contact prints______

Number of photo index maps______ Other material___________

Total flying days_____ Duration of flying in months________

Estimated date, of beginning of work________
of completion of contract___________

Waiting costs ______ months @______ per month ______

Flying costs ______ days @ ______ per day ______

____Rolls of film @ ________ per roll ______

____Contact prints @________per 100 ______

____Photo index maps @ _____ each _______

Total _______

Ownership overhead @ _____% _______

Total _______

Profit at _____% _______

Contingency @ _____% of waiting costs _______

Total cost of project _______

Estimated cost per square mile _______

Estimated cost per sq. mile using next cheapest method _______
Describe the method.

For more refined calculation there is appended a table showing the actual monthly averages for each station shown on the map. It is obvious that the map shows a generalized average for broad zones. When working over a project area, it may be preferable to use the values shown in the table after the station constants have been determined. The table also shows the lowest year on record for the station.